PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON EMPENTA

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

A 11			
Applicant's or agent's file reference F18022 GSK	FOR FURTHER ACTION	See Form PCT/IPEA/416	
International application No.	International filing date (day/month/year)	Priority date (day/month/year)	
PCT/IB2004/002243	09.07.2004	15.07.2003	
International Patent Classification (IPC) or n B01J8/22	ational classification and IPC		
Applicant SASOL TECHNOLOGY (PROPRIE	TARY) LIMITED et al.		
This report is the international pro- Authority under Article 35 and tra	eliminary examination report, established to the applicant according to	ed by this International Preliminary Examining Article 36.	
2. This REPORT consists of a total of 5 sheets, including this cover sheet.			
3. This report is also accompanied	by ANNEXES, comprising:		
1	to the International Bureau) a total of 5		
sheets of the descript and/or sheets contain Administrative Instruc	ning rectifications authorized by this Aut	e been amended and are the basis of this report thority (see Rule 70.16 and Section 607 of the	
sheets which supersond the disclosure Supplemental Box.	e in the international application as file	ority considers contain an amendment that goes d, as indicated in item 4 of Box No. I and the	
sequence listing and/or to	Bureau only) a total of (indicate type arables related thereto, in computer reads e Listing (see Section 802 of the Admir	nd number of electronic carrier(s)), containing a able form only, as indicated in the Supplementain instrative Instructions).	
4. This report contains indications	relating to the following items:		
☐ Box No. I Basis of the o	pinion		
☐ Box No. II Priority			
☐ Box No. III Non-establish	ment of opinion with regard to novelty,	inventive step and industrial applicability	
☐ Box No. IV Lack of unity of	of invention		
Box No. V Reasoned sta applicability;	tement under Article 35(2) with regard citations and explanations supporting su	to novelty, inventive step or industriai uch statement	
☐ Box No. VI Certain docur	nents cited		
☐ Box No. VII Certain defec	ts in the international application		
☐ Box No. VIII Certain obser	vations on the international application		
Date of submission of the demand	Date of comp	pletion of this report	
20.04.2005	31.10.200	95 ,	
Name and mailing address of the internat preliminary examining authority:	ional Authorized C	Officer September Pelenton, Eg	
European Patent Office D-80298 Munich	Thomasso	on. P	
Tel. +49 89 2399 - 0 Tx: 52 Fax: +49 89 2399 - 4465	23656 epmu d	No. +49 89 2399-8339	

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No. PCT/IB2004/002243

	Box No.	I Basis of the report	
1.	With regard to the language, this report is based on the international application in the language in which it filed, unless otherwise indicated under this item.		
	 □ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of: □ international search (under Rules 12.3 and 23.1(b)) □ publication of the international application (under Rule 12.4) □ international preliminary examination (under Rules 55.2 and/or 55.3) 		
2.	. With regard to the elements* of the international application, this report is based on (replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):		
	Descrip	lon, Pages	
	1-19	as originally filed	
Claims, Numbers			
	1-26	received on 25.04.2005 with letter of 20.04.2005	
	Drawings, Sheets		
	1/2, 2/2	as originally filed	
	□ as	equence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing	
3.		e amendments have resulted in the cancellation of: the description, pages the claims, Nos. the drawings, sheets/figs the sequence listing (specify): any table(s) related to sequence listing (specify):	
4.	had not Supple:	s report has been established as if (some of) the amendments annexed to this report and listed below been made, since they have been considered to go beyond the disclosure as filed, as indicated in the nental Box (Rule 70.2(c)). the description, pages the claims, Nos. the drawings, sheets/figs the sequence listing (specify): any table(s) related to sequence listing (specify):	
	* If	item 4 applies, some or all of these sheets may be marked "superseded."	

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No. PCT/IB2004/002243

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1-26

1. Statement

Novelty (N) Yes: Claims

No: Claims

Inventive step (IS) Yes: Claims 1-26

No: Claims

Industrial applicability (IA) Yes: Claims 1-26

No: Claims

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: US-A-5 527 473 D2: WO03/047741

2. The present application meets the requirement of Article 33(2)-(3) PCT:

2.1 Closest prior art

D1 and D2, considered as being equivalent closest prior arts, disclose a process for producing a **liquid** with a **gas** reacting **upwardly** in a liquid/catalyst **slurry**. The liquid product is withdrawn through a **primary filtration stage** (separation of catalyst particles) followed by a **second filtration stage** for separating the fine catalyst particles from the liquid product. Furthermore the **filtrate** of the **second** filtration stage, which does not contain fine particles any more, is **back-flushed** through the filter of the **first** filtration stage in order to **dislodge** the cake from the filter (see D1 and D2: International Search Report).

2.2 Novelty

The subject-matter of claim 1 differs from D1 and D2 in that (1) during the primary filtration stage the catalyst particles having a size from 1 micron to the size of the filter pores ("near-size" catalyst particles) and the fine catalyst particles (less than 1 micron) are collected in a primary filtrate and in that (2) this primary filtrate is subjected to a second filtration stage for separating the "near-size" catalyst particles from the fine catalyst particles. The second filtrate containing liquid and the fine catalyst particles is used for back-flushing the filter medium of the primary filtration stage.

2.3 Inventive step

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (SEPARATE SHEET)

International application No.

PCT/IB2004/002243

The technical problem to be solved against D1 and D2 is to effectively reduce the irreversible blinding of the filter medium of the primary filtration stage during backflushing. This problem is solved by using a liquid containing only fine catalyst particles (size less than 1 micron) for the back-flushing solution. D1 and D2 disclose that all catalyst particles are removed after the second filtration stage; D1 and D2 do not disclose to separate the "near-size" catalyst particles from the fine catalyst particles. In accordance with the process of claim 1 it is not necessary to separate the fine catalyst particles from the secondary filtrate. This would lead to a cost-effective process since it can be very costly to separate fine catalyst particles from a liquid product (high pressure drops, frequent replacement of filter cartridges...). The inventive step can therefore be recognized.

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CLAIMS:

1. A process for producing liquid and, optionally, gaseous products from gaseous reactants, which process includes

feeding, at a low level, gaseous reactants into a slurry bed of solid catalyst particles suspended in a suspension liquid;

allowing the gaseous reactants to react as they pass upwardly through the slurry bed, thereby to form liquid and, optionally, gaseous products, with the reaction being catalyzed by the catalyst particles and with a product mixture comprising liquid product and catalyst particles having a range of sizes, being formed;

subjecting, in a primary filtration stage, the product mixture to primary filtration by passing the liquid product through a filtering medium having a plurality of filtering openings through which the liquid product passes, with the liquid product passing through the filtering openings in a first direction and with the filtering openings having a controlling dimension of x microns, so that large catalyst particles having a particle size greater than x microns are separated from the liquid product, thereby to obtain a primary filtrate comprising liquid product, near-size catalyst particles that range in size from 1 micron to x microns, and fine catalyst particles that are smaller than 1 micron:

subjecting, in a secondary filtration stage, the primary filtrate to secondary filtration to separate the near-size catalyst particles and, optionally, some of the fine catalyst particles, from liquid product, thereby to obtain a secondary filtrate comprising liquid product and fine catalyst particles;

allowing a cake of catalyst particles to build up on the filtering medium in the primary filtration stage;

from time to time interrupting the passage of liquid product through the filtering medium in the primary filtration stage; and

backflushing the filtering medium by passing secondary filtrate, as a flushing liquid, through the filtering medium in a second direction, opposite to the first direction, for at least portions of the periods that the liquid product passage is interrupted, thereby to dislodge the cake from the filtering medium.

- 2. A process as claimed in Claim 1, wherein the suspension liquid is liquid product.
- 3. A process as claimed in Claim 2, wherein the hydrocarbon synthesis is Fischer-Tropsch synthesis, with the gaseous reactants being in the form of a synthesis gas stream comprising mainly carbon monoxide and hydrogen, with both liquid and gaseous hydrocarbon products being produced, and with the catalyst particles thus being Fischer-Tropsch catalyst particles.

- 4. A process as claimed in Claim 3, wherein the slurry bed is provided in a vessel, with unreacted reactants and gaseous product being withdrawn from the vessel above the slurry bed, and with the vessel being maintained at Fischer-Tropsch synthesis pressure and temperature conditions.
- 5. A process as claimed in Claim 4, wherein the catalyst is an iron-based or a cobalt-based Fischer-Tropsch catalyst.

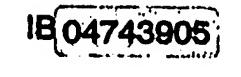
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- A process as claimed in Claim 5, wherein the catalyst is an iron-based Fischer-Tropsch catalyst, with the controlling dimension of the filtering openings being 25 microns, with catalyst particles larger than 25 microns being filtered out in the primary filtration stage and forming the cake on the filtering medium, and with catalyst particles having sizes in the range 1 micron to 25 microns being near-size catalyst particles, while those smaller than 1 micron are fine catalyst particles.
- 7. A process as claimed in Claim 6, wherein the catalyst is a cobalt-based Fischer-Tropsch catalyst, with the controlling dimension of the filtering openings being 10 microns.
 - 8. A process as claimed in any one of Claims 4 to 7 inclusive, wherein the filtering medium is part of a filter element which is mounted inside

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the vessel and is of elongate form, with the filtering medium being of cylindrical form and enclosing a filtrate collecting zone, and with a filtrate outlet for withdrawing filtrate being provided at one end of the filter-element.

- 5 9. A process as claimed in Claim 8, wherein the primary filtration stage is located inside the slurry bed.
 - A process as claimed in Claim 9, which includes providing a plurality of the filter elements, located at different levels within a filtration-zone below the upper surface of the slurry bed.
 - A process as claimed in Claim 10, wherein the passage of the liquid product through the filtering media is effected by applying a pressure differential across the filtering media and any cake build-up thereon.
 - 12. A process as claimed in Claim 11, wherein the pressure differential is effected by withdrawing the primary filtrate into a primary filtrate collection vessel which is at a lower pressure than the vessel, with the filtrate outlets of the filter elements being connected to the primary filtrate collection vessel by means of liquid product conduits.
 - 13. A process as claimed in Claim 11 or Claim 12, wherein the secondary filtration stage is located outside the vessel.
- 25 14. A process as claimed in Claim 13, wherein the secondary filtration stage is provided by a vertically or horizontally orientated pressure leaf filter.
- 15. A process as claimed in Claim 13 or Claim 14, wherein the secondary filtration stage includes filterable granular filter aid material.
 - 16. A process as claimed in any one of Claims 11 to .15 inclusive, wherein the backflushing is effected for at least portions of the periods that the

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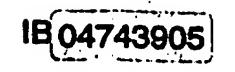
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liquid product passage through the filtering media of the primary filtering stage is interrupted.

- 17. A process as claimed in Claim 16, wherein the backflushing is effected in pulse-like fashion.
 - A process as claimed in Claim 17, wherein the backflushing comprises an initial pulse of flushing liquid, followed by one or more further pulses of flushing liquid, with each backflushing pulse comprising initiating backflushing rapidly, and backflushing the elements rapidly with a volume of the flushing liquid.
 - 19. A process as claimed in Claim 18, wherein the volume of flushing liquid used during the initial pulse is at least three times the internal volume of the filter elements.
 - 20. A process as claimed in Claim 19, wherein the volume of flushing liquid used during a second pulse is less than that used during the initial pulse.
 - A process as claimed in any one of Claims 10 to 20 inclusive, wherein the pressure differential across the filtering media and filter cake during backflushing is up to 10 bar depending on the degree of clogging or age of the filtering media.
 - 22. A process as claimed in any one of Claims 10 to 21 inclusive, wherein the flushing liquid flow rate is at least 6000 ℓ /h/m² of filtering media.
- A process as claimed in any one of Claims 10 to 22 inclusive, which includes subjecting the filter elements to a waiting period during which no filtering or backflushing takes place, so that there is then thus no liquid flow through the filtering media of the elements, to enhance subsequent filtration.



- A process as claimed in any one of Claims 8 to 23 inclusive, which includes agitating the slurry in the slurry bed, to inhibit settling of catalyst particles.
- A process as claimed in Claim 24, wherein the agitation includes allowing slurry in the slurry bed to pass downwardly from a high level to a lower level, through at least one downcomer.
- 26. A process as claimed in Claim 25, which includes operating the vessel such that the slurry bed is in a heterogeneous or chum-turbulent flow regime and comprises a dilute phase consisting of fast-rising large bubbles of gaseous reactants, and possibly gaseous products, which traverse the reaction zone or slurry bed virtually in a plug flow manner, and a dense phase comprising liquid product, solid catalyst particles and entrained smaller bubbles of gaseous reactants and gaseous product.